Lakes and Ponds

Lakes and ponds provide habitat for many plants, insects, fish, birds and other wildlife, and important recreational opportunities for many Missourians.

Estimated Time

Three 50-minute class sessions

Technology Tools/Skills Used in Chapter

- Invertebrate sampling technique for assessing water quality
- Invertebrate identification using a dichotomous key

Safety Precautions/Concerns

None

Vocabulary

Filter feeder
Pond succession

Chapter Objectives

Students will be able to:

1. Diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together, including how depth zones determine where populations of species live in the lake.
2. Compare and contrast the adaptations of plants and animals living in lakes and ponds to those of other aquatic and terrestrial species.
3. Diagram and describe the transfer of energy in a pond food web.
4. Predict the impact of storm water runoff on the organisms in a pond ecosystem. Describe how technological solutions to problems, such as dams, intensive agriculture and urban development, can have risks and unintended consequences. Describe possible solutions to potentially harmful environmental changes within a pond ecosystem.
5. Assess the health of a pond based on the presence or absence of aquatic invertebrates.

Targeted Grade-Level Expectations

EC.1.A.6.a.
EC.1.B.6.a.
EC.1.B.6.b.
EC.1.B.6.c.
EC.2.A.6.a.
EC.2.A.6.b.
EC.1.D.6.a.
EC.1.D.6.b.
EC.1.D.6.c.
IS.1.C.6.a.

Reference Material for Teacher Background

- African Clawed Frogs (SCI013)
- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Introduction to Crayfish (FIS011)
- Introduction to Missouri Fishes (FIS020)
- Know Missouri's Catfish (FIS003)
- Life Within the Water (FIS034)
- Missouri Toads and Frogs (E00430)
- Missouri Turtles (E00468)
- Nuisance Aquatic Plants in Missouri Ponds and Lakes (FIS110)
- Poster: Missouri Fishes (E00013)
- Poster: Missouri Pond Life (E00002)
- Poster: Toads & Frogs (E00012)
- Stream Insects/Crustaceans ID (STR250)
- *Crayfishes of Missouri* (01-0250)
- *Fishes of Missouri* (01-0031)

- *Amphibians and Reptiles of Missouri* (01-0190)
- *Pond Life: Revised and Updated (A Golden Guide from St. Martin's Press)* by George K. Reid

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Missouri Pond Life poster (E00002)
- TV/DVD player
- Notebook paper
- Pens or pencils
- 30 wooden stakes approximately 4 foot in length, or music stands, or masking tape
- *A-Mazing Macroinvertebrates* signs on paper or cardstock and laminated or placed in plastic sheet protectors
- Chalk, plastic non-adhesive survey tape or spray paint for outside activity; vinyl electrical tape, string or plastic non-adhesive survey tape for indoor activity

Activity 8.1: Exploration of Students' Current Understanding of Missouri's Lake and Pond Ecosystems

This activity explores students' current understanding of Missouri's lake and pond ecosystems.

Estimated Time

15 minutes

Required Materials

- Missouri Pond Life poster (E00002)
- Notebook paper
- Pens or pencils

Procedure

1. Display the Missouri Pond Life poster in the classroom.

2. Ask students to use their notebooks to free-write, brainstorm, mind-map or cluster for five minutes everything they know about lakes and ponds. Lead class discussion by asking each student to contribute something to the board without repeating an item. Have students add to their notebooks any information on the board that they hadn't already included. Leave these items on the board for use in Activity 8.2.

3. Explain to the class that this chapter will help them understand what a lake ecosystem is and how it functions.

Activity 8.2: Video Exploration of Missouri's Lake and Pond Ecosystems

This activity helps students understand Missouri's lake and pond ecosystems.

Estimated Time

35 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player
- Notebook paper
- Pens or pencils

Procedure

1. Show the video clips: "CAP Lakes" and "Farm Pond Stocking." Pause the video frequently and discuss facts, concepts and misunderstandings students wrote on the board in Activity 8.1 as they arise in the video.

2. Have students make notes in their science notebooks.

Activity 8.3: Student Reading and Research

This activity provides students with definitions and explanations about Missouri's lake and pond ecosystems.

Estimated Time

Varies—class time may be provided or reading may be assigned as homework. Allow at least 20 minutes for in-class questions and discussion.

Required Materials

- Student Guide
- Notebook paper (optional)
- Pens or pencils (optional)

Procedure

1. Have students read Chapter 8: Lakes and Ponds. Introduce vocabulary terms as needed.

2. Assign the **Questions to Consider** as homework or use them in a cooperative learning activity.
    1. How do oxygen levels in ponds change during each 24-hour period?
    Oxygen levels in a pond are high while the sun is shining and plants are photosynthesizing, but they can drop dramatically at night, killing fish and other aquatic animals.
    2. What kind of organism makes up the greatest amount of living material in a pond?
    Plankton makes up about 87 percent of the living stuff in a pond.
    3. Besides providing food, what other roles do plants have in lake and pond ecosystems?
    As plants move in, they sink their roots into the pond bottom and hold the soil, making the water even clearer and allowing more plants to grow at greater depths. Plants give off oxygen as a byproduct of photosynthesis. Small animals seek shelter among the plants and parts of plants growing underwater, which offer hiding places from predators. Plant beds serve both as shelter from predators and as a food source for insects.
    4. How are plants that live under water similar to plants that live on land? How are they different?
    Plants that live underwater are like plants that live above water. They need water, carbon dioxide, sunlight and nutrients such as phosphorous and nitrogen. But water plants have special adaptations that help them thrive in their underwater environment. Waxy or slimy coatings protect them from drying out when water levels drop. Porous stems or leaves let them absorb minerals right from the water.
    5. How do ponds change over time?
    As ponds age, they fill with sediment and organic material. They become smaller, shallower ponds. In time the pond will become a wetland, then as it fills even more, a meadow. This natural process is called pond succession.
    6. How are lakes similar to ponds? How are they different?
    Lakes are bigger than ponds. While lakes and ponds have much in common, a lake's larger size makes for some differences. In a lake, the amount of oxygen dissolved in the water stays pretty even over a 24-hour period. Wind on a lake can whip up high waves mixing oxygen into the water. The ecology of the lake's shoreline zone is like a pond's ecology. A lake also has an open-water zone away from shore, as far down as sunlight reaches. Most large fish spend most of their time in this zone, swimming into the shoreline zone now and then to feed or spawn. In the deep-water zone, below the open-water zone, not enough light reaches the bottom for plants to grow. This makes the deep-water zone oxygen poor, and not much lives there. Dead organic matter sinks to the lake bottom, where bacteria and other

decomposers break it down. The temperature in a lake is fairly even from day to day in a given season. However, in summer, lake water is much warmer on top in the shoreline zone and the open-water zone than in the deep-water zone. In the fall, temperature changes cause the layers to mix, bringing decaying organic matter from the bottom up to the surface. This is a natural process that mixes nutrients, minerals and oxygen throughout the lake.

7. How can lakes and ponds be kept healthy?
   Because every waterbody is a reflection of its watershed, good watershed management is important to keeping a pond healthy. Stopping excess erosion and runoff loaded with fertilizers, pesticides or other pollutants is key. Keeping a 100-foot-wide buffer of thick plant growth around the pond helps filter out pollutants and eroded earth before they reach the pond. A plant buffer will greatly improve the pond's health and extend its life. The same is true for lakes.

Activity 8.4: Student Investigation of Pond Anatomy and Lake and Pond Food Webs

This activity helps students understand lake and pond food webs.

Estimated Time

25 minutes

Required Materials

- Missouri Pond Life poster (E00002)
- Notebook paper
- Pens or pencils
- Red, green and black yarn
- Scissors
- Pushpins or thumbtacks

Procedure

1. Display the Missouri Pond Life poster in the classroom.

2. Have students take turns cutting lengths of yarn and using pushpins, attach them to the poster to diagram the food web connections between the plants and animals depicted in the poster. Tell students to use red yarn to connect a predator to its prey. Have students use green yarn to connect primary consumers to producers. Use black yarn to connect scavengers and decomposers to their food.

3. Lead class discussion of lake and pond food webs, with reference to the poster and to FIG. 8.8 in the Student Guide.

4. Ask students to predict the impact of storm water runoff on the organisms in a pond ecosystem. (As water runs downhill through the pond's watershed, it picks up small bits of soil and anything else that can be moved. This erosion brings sediment to the pond, replacing water with soil and creating more shallow areas. Decaying plants and animals fall to the pond bottom, adding to and enriching the sediment. Plants thrive in the rich sediment and take up more space. In time the pond will become a wetland, then as it fills even more, a meadow. This natural process is called pond succession. The surface water that fills a pond also can bring trouble in the form of pollution. Excess soil and plant nutrients can overload the pond and unbalance its growth cycle. A common result of this imbalance is too much algae growth. Algae overgrowth makes the water cloudy and shades out rooted plants. When the excess algae dies, it creates a lot of decomposing material that uses up oxygen and chokes fish. This can speed up pond succession.)

5. Have students write science notebook entries diagramming the parts of a lake and explaining how the biotic and abiotic factors that make up the lake ecosystem function together, including how the depth zones of a lake determine where populations of species live in the lake.

Activity 8.5: Video Instruction for Invertebrate Sampling

This activity helps students understand the techniques used for invertebrate sampling. It helps students understand the use of biodiversity and indicator species to assess water quality.

Estimated Time

25 minutes

Required Materials

- Volunteer Water Quality Monitoring Instructional Video
- TV/DVD player
- Notebook paper
- Pens or pencils

Procedure

1. Explain that, besides testing the physical and chemical characteristics of the water, water quality experts also look for certain invertebrates that live among the plants and in the bottom at the edge of the lake or pond. Examples include the immature stages of dragonflies, damselflies and mayflies. These insects are sensitive to pollution. The presence of such species generally indicates good quality water. When they are missing from a lake or pond or when only pollution tolerant species such as black fly larvae and bloodworms are present, we know that something is wrong with the water. Biodiversity—a high number of species—as well as a high number of sensitive species living in a lake or pond are good signs of its health. Explain that the video will show them how to sample a lake or pond for invertebrates. Finding a diverse group of invertebrates, including those that are sensitive to pollution, indicates that the lake or pond has high water quality.

2. Show the video clip: "Pond Invertebrate Sampling." Ask students to follow along on the instruction sheet as the different sampling methods are depicted. Pause the video as needed to clarify, discuss and review.

3. If desired, distribute copies of the Invertebrate Sampling Instructions and data pages (see Field Study Day section) for students to follow along with the video.

Activity 8.6: Student Investigation of Invertebrate Identification

Adapted from "A-Mazing Macroinvertebrates" by Rhonda Anderson, Missouri Department of Conservation

This activity helps students learn to identify invertebrates in preparation for their field study day. It helps students understand how to use dichotomous keys.

Estimated Time

25 minutes

Required Materials

- 30 wooden stakes approximately 4 foot in length, or music stands, or masking tape
- *A-Mazing Macroinvertebrates* signs (printed from a PDF on DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*) on paper or cardstock and laminated or placed in plastic sheet protectors
- Chalk, plastic non-adhesive survey tape or spray paint outside, or vinyl electrical tape, string or plastic non-adhesive survey tape indoors

Procedure

1. This activity is a maze that uses a large open space such as a grassy field or a gymnasium. This activity lends itself better to outdoor situations, but it can be done inside when ample space is available.

2. Using a permanent marker, write the letter corresponding to the layout on the back of each sign. Write a corresponding letter on each invertebrate picture to allow the student to know if he or she has correctly identified the invertebrate.

3. For an outdoor setup, use 30 wooden stakes approximately 4 foot in length. Attach the signs with staples or velcro and drive stakes into the ground. For an indoor setup, use music stands or tape the signs directly on the floor.

4. Make lines connecting the stations at right angles. Use chalk, plastic non-adhesive survey tape or spray paint outside or vinyl electrical tape, string or non-adhesive survey tape inside. Always ask permission to use spray paint before applying to grass of a public lawn. If using string or tape, be sure to place it close to the ground at each station to avoid tripping.

5. This key was designed for use with specific invertebrates. Pictures of the 15 invertebrates are included to ensure that the students are able to properly key them out. Each invertebrate should be labeled with letters corresponding to the sign. This way the students will be able to know immediately if they are correct. (Caution, some students will just look for the matching letter!) You will also be able to match the invertebrate to the answer key and know if the students are correct.

6. Walk through the maze with a couple of different invertebrates to ensure that the maze is set up correctly.

7. Emphasize to students the importance of proper handling of the pictures to minimize wear. Review with the class the important points of invertebrate anatomy before starting. These include: head, thorax, abdomen, gills, wing pads, prolegs, segmented legs and lateral filaments.

8. Allow students to select an invertebrate and review its anatomy. Explain any vocabulary words that may be unfamiliar to the students. The key to success is in looking at the correct body part for each clue.

9. Go over the first clue with the students and explain how to follow the maze. Tell them to read both options before making any decisions.

10. Each student should walk through the maze with the picture of the invertebrate in hand, making choices and eventually reaching a dead end—the name of their invertebrate.

11. Sometimes students will need correction on a selection. Encourage them to return to the start of the maze until their invertebrate is correctly identified.

12. Encourage students to select another invertebrate and repeat the process as time permits.

13. Students can be paired up to go through the maze. Students having problems can be reassigned a partner who has been successful at identifying several invertebrates.

Chapter 8 Assessment

Directions

Select the best answer for each of the following multiple-choice questions.

1. Predict the impact of sediment and nutrients brought by storm water runoff on the organisms in a lake or pond ecosystem.
   a. Temperature changes would cause the layers to mix, bringing decaying organic matter from the bottom up to the surface.
   b. There would be no long-term damage.
   c. Pond succession would speed up.
   d. All of the above

2. Predict the oxygen level in a pond.
   a. The amount of oxygen dissolved in the water stays pretty even over a 24-hour period.
   b. The water is too deep for plants to grow on the bottom, making it oxygen poor.
   c. Oxygen levels are high each day while the sun is shining and plants are photosynthesizing, but they can drop dramatically at night.
   d. None of the above

3. Which of the following is important to slowing pond succession and keeping a pond healthy:
   a. Keeping a 100-foot-wide buffer of thick plant growth around the pond
   b. Stopping excess erosion
   c. Stopping runoff loaded with fertilizers, pesticides or other pollutants
   d. All of the above

4. A lake has most of its life:
   a. In a ring around the shoreline, reaching out as far as it can survive
   b. In open-water zone away from shore, as far down as sunlight reaches
   c. In the deep-water zone
   d. Both a and c

5. Plants living in lakes and ponds:
   a. Have long, thin, flexible stems that offer little resistance to the current and strong root systems to hold them in place
   b. Include tiny, free-floating species of algae and are the food base of the ecosystem
   c. Have waxy or slimy coatings protect them from drying out when water levels drop, and porous stems or leaves let them absorb minerals right from the water
   d. Both b and c

Chapter 8 Assessment

Directions

Write your own answer for each of the following questions.

1. Describe how technological solutions to problems can have risks and unintended consequences. Justify your answer by using one of the following as an example:
   - Damming a stream to create a lake or pond
   - Urban development in the watershed of a lake or pond
   - Intensive agriculture (such as cattle or row crops) in the watershed of a lake or pond

2. Suggest a possible solution to potentially harmful environmental changes within a stream ecosystem caused by the technical solution you chose in the previous question.

3. On a separate sheet of paper, diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together.

Chapter 8 Assessment Answer Key

Multiple-choice questions

1. Predict the impact of sediment and nutrients brought by storm water runoff on the organisms in a lake or pond ecosystem.
   c. Pond succession would speed up.

2. Predict the oxygen level in a pond.
   c. Oxygen levels are high each day while the sun is shining and plants are photosynthesizing, but they can drop dramatically at night.

3. Which of the following is important to slowing pond succession and keeping a pond healthy:
   d. All of the above

4. A lake has most of its life:
   a. In a ring around the shoreline, reaching out as far as it can survive

5. Plants living in lakes and ponds:
   d. Both b and c

Write-in questions

1. Describe how technological solutions to problems can have risks and unintended consequences. Justify your answer by using one of the following as an example:
   - Damming a stream to create a lake or pond
   - Urban development in the watershed of a lake or pond
   - Intensive agriculture (such as cattle or row crops) in the watershed of a lake or pond

   Many answers are possible, but should resemble one of the following examples:

Technological solution	Potential risk or unintended consequence
Damming a stream to create a lake or pond	Damming a river turns the stream ecosystem into a lake ecosystem. Species adapted to live in flowing water may not be able to survive in the still water of the lake or pond. Also, as dams slow and stop the flow of water, the sediment the water carried drops out and builds up as the stream becomes lake or pond, further destroying stream habitat. Eventually the lake or pond will fill with sediment, becoming solid ground. Below the dam, the rushing water scours out the stream bed, destroying more habitat and causing severe erosion downstream. Dams also prevent fish from moving up or down stream, potentially isolating them from other populations or from spawning grounds upstream.
Urban development in the watershed of a lake or pond	Urban development can speed up erosion, and surface water from the watershed can bring sediment to the pond, replacing water with soil and creating more shallow areas. Excess soil and plant nutrients can overload the pond and unbalance its growth cycle. This can speed up pond succession. Water from sewage treatment plants may be piped back into lakes or ponds after treatment. Stormwater that runs off paved roads, rooftops and parking lots flows into ditches and storm drains. This water then may drain directly a lake or pond without any filtration or treatment. Excess fertilizer, pesticides, mud, motor oil and antifreeze, trash, even lawn clippings and pet waste wash off pavement into waterways during heavy rains, creating significant hazards for swimmers and for people using the lake or pond for drinking water. Rainwater running off a hot asphalt parking lot after a summer storm can dump hot water into a pond, killing everything in it.

Intensive agriculture (such as cattle or row crops) in the watershed of a lake or pond	Plowing and overgrazing can speed up erosion, and surface water from the watershed can bring sediment to the pond, replacing water with soil and creating more shallow areas. Excess soil and plant nutrients can overload the pond and unbalance its growth cycle. This can speed up pond succession. Organic pollution occurs when too much organic matter, such as manure or sewage, gets in the water. The decaying organic matter uses up a lot of oxygen. Animal waste and bacteria from feedlots can create significant hazards for swimmers and for people using the lake or pond for drinking water. Organic pollution also can happen when inorganic pollutants such as nitrates and phosphates build up in the water. Farmers use nitrates and phosphates as fertilizers because they help plants grow. High levels of these plant nutrients in the water feed the growth of plants and algae. Too much plant growth at the surface can block light from reaching deeper water. Then as the plants and algae die and decompose, they use up the supply of dissolved oxygen. The process of rapid plant growth followed by rotting and oxygen loss can result in the death of fish and other animals in the lake or pond.

2. Suggest a possible solution to potentially harmful environmental changes within a stream ecosystem caused by the technical solution you chose in the previous question.
   Many answers are possible, but should resemble one of the following examples:

Technological solution	Potential risk or unintended consequence	Possible solution
Damming a stream to create a lake or pond	Damming a river . . . spawning grounds upstream.	Remove or do not build dams. If this is not possible, create new habitat elsewhere to make up for habitat lost to the dam. Dredging may be necessary to slow down succession in the lake or pond. Spawn fish artificially. Create fish passages around the dam (fish ladders). Build something (partial barriers, check dams, grade control structures) to slow the water down when it comes out of the dam, to reduce damage downstream.
Urban development in the watershed of a lake or pond	Urban development can . . . killing everything in it.	Because every waterbody is a reflection of its watershed, good watershed management is important to keeping a pond healthy. Stopping excess erosion and runoff loaded with fertilizers, pesticides or other pollutants is key. Keeping a 100-foot-wide buffer of thick plant growth around the pond helps filter out pollutants and eroded earth before they reach the pond. A plant buffer will greatly improve the pond's health and extend its life. The same is true for lakes.
Intensive agriculture (such as cattle or row crops) in the watershed of a lake or pond	Plowing and overgrazing . . . lake or pond.	Because every waterbody is a reflection of its watershed, good watershed management is important to keeping a pond healthy. Stopping excess erosion and runoff loaded with fertilizers, pesticides or other pollutants is key. Keeping a 100-foot-wide buffer of thick plant growth around the pond helps filter out pollutants and eroded earth before they reach the pond. A plant buffer will greatly improve the pond's health and extend its life. The same is true for lakes. Missouri farmers have switched to no-till planting and other conservation farming techniques to reduce the amount of soil and other sediment in Missouri lakes and ponds.

3. On a separate sheet of paper, diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together.
   Refer to FIG. 8.8 in the Student Guide to assess potential responses.

Enrichments

Project WET:

- Macroinvertebrate Mayhem

Project WILD Aquatic:

- Glass Menagerie
- Micro Odyssey
- Pond Succession

Service learning:

- Storm drain stenciling
- Litter pickup

Guest speaker:

- Lake and pond manager

Video clips:

- Crappie Radio Tagged